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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/821,505 | 03/30/2001 | Ronald B. Foster | 1610-2002 | 4889 |

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| EXAMINER | |
|---|---|
| ALEJANDRO, RAYMOND | |
| **ART UNIT** | **PAPER NUMBER** |
| 1745 | |

DATE MAILED: 09/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. 09/821,505 | Applicant(s) FOSTER, RONALD B. | |
|---|---|---|---|
| | Examiner Raymond Alejandro | Art Unit 1745 | |

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *21 August 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *37-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *37-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 August 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

### *Election/Restrictions*

1. Applicant's cancellation of claims 1-36 in Paper No. 10 is acknowledged.

### *Information Disclosure Statement*

2. The information disclosure statement (IDS) submitted on 06/27/01 was considered by the examiner.

### *Drawings*

3. The sheets of drawings filed on 08/03/01 have been accepted.

### *Specification*

4. The disclosure is objected to because of the following informalities: the specification makes reference to a US patent application (see page 14, section 0044), however, the current status of such application should also be included. Appropriate correction is required.

5. The disclosure is objected to because of the following informalities: the specification contains no description of Figures 3A-F and 4A-D. Appropriate correction is required.

### *Claim Rejections - 35 USC § 112*

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claim 45 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. Claim 45 contains the trademark/trade name "NAFION". Where a trademark or trade name is used in a claim as a limitation to identify or describe a particular material or product, the claim does not comply with the requirements of 35 U.S.C. 112, second paragraph. See *Ex parte Simpson*, 218 USPQ 1020 (Bd. App. 1982). The claim scope is uncertain since the trademark or trade name cannot be used properly to identify any particular material or product. A trademark or trade name is used to identify a source of goods, and not the goods themselves. Thus, a trademark or trade name does not identify or describe the goods associated with the trademark or trade name. In the present case, the trademark/trade name is used to identify/describe a polymeric material and, accordingly, the identification/description is indefinite.

### *Claim Rejections - 35 USC § 103*

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 37-41, 43-50 and 53-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jankowski et al 2003/0138685 in view of Maynard et al 6541149.

The instant application is directed to an integrated circuit wherein the disclosed inventive concept comprises a fuel cell integrated to a substrate and a circuit. Other limitations include the

integrated circuit; the fuel cell body; the substrate material; the polymer electrolyte material and its thickness; the catalyst material; the transition layer; and the water barrier.

As to claims 37-40:

Jankowski et al disclose a fuel cell integrated to a circuit wherein the fuel cell comprises a polymer membrane electrolyte, a porous substrate; a catalyst material, anode collector and a cathode collector and an integrated circuitry; and the driven device is a heater (ABSTRACT/ SECTIONS 0002, 0006 and 0030).

(57) **ABSTRACT**

A micro-electro-mechanical systems (MEMS) based thin-film fuel cells for electrical power applications. The MEMS-based fuel cell may be of a solid oxide type (SOFC), a solid polymer type (SPFC), or a proton exchange membrane type (PEMFC), and each fuel cell basically consists of an anode and a cathode separated by an electrolyte layer. The electrolyte layer can consist of either a solid oxide or solid polymer material, or proton exchange membrane electrolyte materials may be used. Additionally catalyst layers can also separate the electrodes (cathode and anode) from the electrolyte. Gas manifolds are utilized to transport the fuel and oxidant to each cell and provide a path for exhaust gases. The electrical current generated from each cell is drawn away with an interconnect and support structure integrated with the gas manifold. The fuel cells utilize integrated resistive heaters for efficient heating of the materials. By combining MEMS technology with thin-film deposition technology, thin-film fuel cells having microflow channels and full-integrated circuitry can be produced that will lower the operating temperature an will yield an order of magnitude greater power density than the currently known fuel cells.

[0002] The present invention relates to fuel cells, particularly to small, compact fuel cells, and more particularly to a miniature power source composed of a stack of fuel cells fabricated by combining MEMS and thin film deposition technologies to produce fuel cells with microflow channels, fully-integrated control circuitry, and integrated resistive heaters.

[0030] As has been shown in FIG. 1, the incorporation of manifold structure within the host substrate through micromachining techniques enables a complete fuel cell device to be realized which can be readily attached to fuel and oxidant sources. FIG. 3 illustrates an exploded view a complete fuel cell stack including the resistive heater, not shown in the FIGS. 1-2 embodiment. In the approach of FIG. 3, the fuel cell generally indicated at 40, includes a membrane-electrode assembly created by thin-film deposition techniques, or a combination of laminate, thin film and thick film assembly techniques and generally indicated at 41, and a micromachined substrate-manifold assembly or system generally indicated at 42. Integrated circuit type microfabrication processes are used to pattern the electrode contacts, as well as to form a resistive heater element within the fuel cell stack structure. The components of the membrane-electrode assembly 41 is subsequently formed into a free standing membrane by selective etching of openings or windows 43 in a substrate 44 on which the components are deposited as in the FIG. 2 embodiment, the substrate 44 being an upper component of the manifold assembly 42. In an alternative embodiment, the components of the membrane-electrode assembly 41 is subsequently formed on a porous thick film membrane or host structure which is positioned over the openings or windows 43 in a substrate 44 on which the components are formed, the substrate 44 being an upper component of the manifold assembly 42. Manifold channels are micromachined in another substrate 45, the lower components of the manifold assembly 42, which is subsequently bonded to the substrate 44. The membrane electrode assembly 41 includes an electrode (anode) 46 having a contact pad 47, a heater isolation member 48 having openings or window 49 which align with openings or windows 43 of substrate 44, a resistive heater 50 having contact pads 51 and 52 and constructed so as not to cover the openings 49 in member 48, an electrolyte 53, and an electrode (cathode) 54 having a contact pad 55. For example, the electrode/electrolyte/electrode (components 46, 53 and 54) may be composed of nickel (Ni)-yttria stabilized zirconia (YSZ)-silver (Ag), the resistive heater 50 composed of platinum, and the heater isolation member 48 composed of silicon dioxide or other material which provides electrical isolation from the electrodes with openings 49 being 2 mm×2 mm, and with the substrates 44 and 45 composed preferably of silicon but may be composed of glass, ceramic, plastic, or other material having the qualities described above, with windows 43 being 2 mm×2 mm.

Figures 1, 5-6 and 8 illustrate the fuel cell configuration:

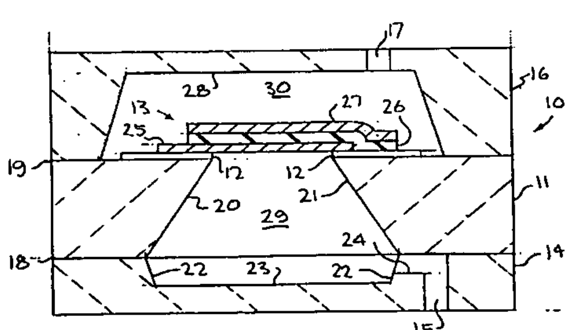


FIG. 1

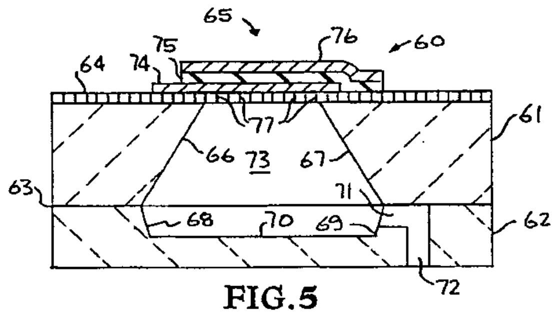

FIG.5

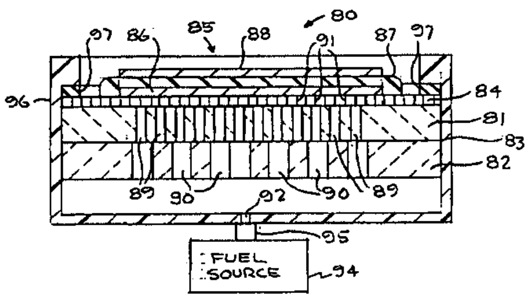


FIG.6

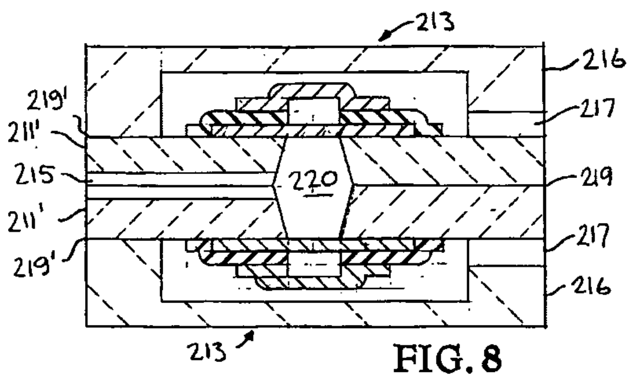

FIG.8

As to claim 41:

It id disclosed that the substrate is made of silicon (Section 0028, 0029, 0036).

the Si-based substrates

As to claims 44-45:

It is disclosed that the electrolyte is made from Nafion (SECTION 0038).

num with a thickness of 1000 A to 2 microns; and the electrolyte/catalyst **75** being composed Ni/YSZ, Pt/Nafion, or Pt/C/Nafion with a thickness of 1 micron to 50 microns

As to claims 46-48:

It is disclosed that the electrolyte thickness is thinner than 1-2 μm (Section 0005 & 0045).

shorting through the electrolyte layer. This enables the electrolyte layer to be on the order of 1 $\mu$m thick rather than

rechargeable batteries as a miniature power source. Since the fuel cell electrolyte layer can be made thinner, e.g. 1-2 $\mu$m thick as compared to 1 mil, then the operating temperature

As to claims 49-50:

It is disclosed that the catalyst comprises at least Pt (SECTION 0038).

num with a thickness of 1000 A to 2 microns; and the electrolyte/catalyst 75 being composed Ni/YSZ, Pt/Nafion, or Pt/C/Nafion with a thickness of 1 micron to 50 microns

As to claims 52 (see also rejection below of claim 52) and 53-54:

It is disclosed that additional layers of catalyst materials can also separate the electrode (cathode or anode) from the electrolyte (SECTION 0035). *It is thus noted that the additional catalyst layers can also act as the transition layer for lowering the electrical resistance as well as the water barrier adjacent to the back surface catalyst material.*

membrane electrolyte materials. Additional layers of catalyst materials can also separate the electrode (cathode or anode) from the electrolyte. In these embodiments micromachined manifolds can be utilized to transport the fuel and oxidant, to each cell and a provide a path for exhaust gases.

Jankowski et al disclose a MEMS-based thin-film fuel cell according to the above-mentioned aspects. However, Jankowski et al do not disclose the specific gas-diffusion region; and the particular semiconductor substrate.

With respect to claim 37:

Maynard et al disclose a micro fuel cell formed by using a silicon substrates wherein the silicon substrate comprises a porous silicon gas diffusion regions 32, 63 or 85 (ABSTRACT/COL 3, lines 46-47/ COL 6, lines 19-20/ COL 6, lines 60-62).

With respect to claim 43:

It is disclosed that the substrate is made from $SiN_x$ (COL 7, lines 50-52) or boron-doped silicon substrates (COL 8, lines 54-56).

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to make the fuel cell of Jankowski et al by having the specific gas-diffusion region of Maynard et al as Maynard et al teach that such gas diffusion regions allow gas to diffuse into the fuel cell. Thus, gas is able to diffuse through the porous diffusion layer region.

As to the particular semiconductor substrate, it would have been obvious to the skilled artisan to use the particular semiconductor substrate of Maynard et al as the substrate material of Jankowski et al as Maynard et al teach that semiconductor materials can be used as substrate because they have sufficient mechanical strength, can withstand the operating temperature of the fuel cell and can be micromachined or lithographic processed to form the desired fuel cell structure.

11. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jankowski et al 2003/0138685 in view of Maynard et al 6541149 as applied to claim 37 above, and further in view of Gorer 6498121.

Jankowski et al and Maynard et al are applied, argued and incorporated herein for the reasons above. In addition, the preceding prior art does not disclose the substrate comprising sapphire.

Gorer teaches a fuel cell electrode embodiment wherein the independent electrodes were fabricated on inert substrates such as sapphire and thermally treated silicon (COL 8, lines 60-67).

Thus, it would have been obvious to one skilled in the art at the time the invention was made to use the substrate comprising sapphire of Gorer as the additional substrate material of both Jankowski et al and Maynard et al because Gorer discloses that the sapphire material can be used as an inert substrate wherein an array of independent fuel cell electrodes can be fabricated thereon. Thus, Gorer directly teaches that sapphire substrates are inert and suitable for fuel cell applications.

12. Claims 51-52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jankowski et al 2003/0138685 in view of Maynard et al 6541149 as applied to claim 37 above, and further in view of Lin 5750013.

Jankowski et al and Maynard et al are applied, argued and incorporated herein for the reasons above. In addition, the preceding prior art does not disclose the specific catalyst materials.

Lin discloses that in the application to fuel cell, the catalyst material used is mainly Pt or the alloy of Pt with one or more metals such as Rh, or Pd as well as gold, nickel and Ir (COL 4, lines 15-25).

> **reactors, and sensors. For example, in the application to fuel cells, the metal used is mainly Pt or the alloy of Pt with one or more metals selected from the group consisting of gold, the metals of Group VB (such as V, Nb, Ta), the metals of Group VIII (such as Fe, Co, Ni, Ru, Rh, Pd, Os, Ir), the metals of Group VII B (such as Mn, Tc, Re), and the metals of Group VI B (such as Cr, Mo, W) of the periodic table. In**

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to use the specific catalyst materials of Lin in the fuel cell of both Jankowski et al and Maynard et al as Lin teaches these catalyst materials are suitable for fuel cell

applications because they are active catalytic materials which are chemically compatible with the fuel cell chemical reactions, the reactants and the electrode materials employed in the fuel cell. Thus, these catalyst materials are chemically compatible with the chemistry and reacting environment of the fuel cell.

### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Raymond Alejandro whose telephone number is (703) 306-3326. The examiner can normally be reached on Monday-Thursday (8:30 am - 7:00 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan can be reached on (703) 308-2383. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Raymond Alejandro
Examiner
Art Unit 1745